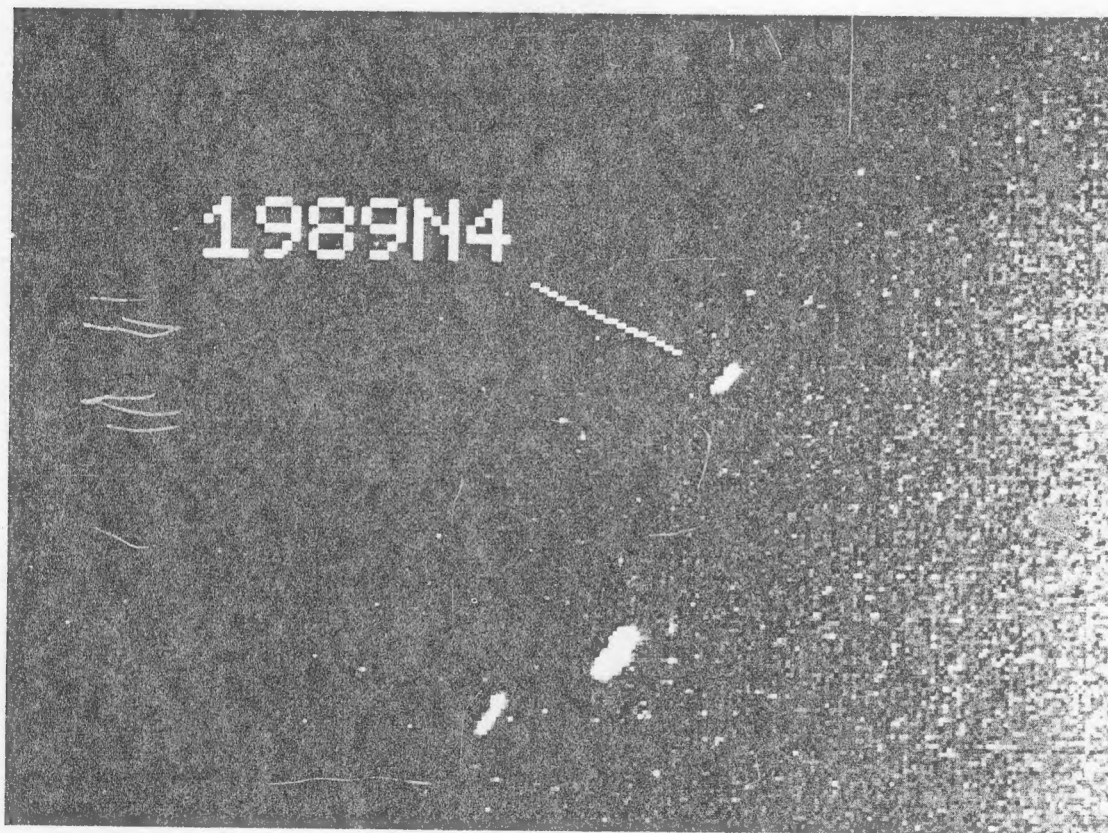


Voyager

B U L L E T I N

MISSION STATUS REPORT NO. 90

AUGUST 11, 1989



One of two ring arcs discovered in Voyager 2 images is seen just outside the orbit of the recently discovered moon 1989 N4. (P-34578)

Ring Arcs Confirmed!

Voyager's imaging science team has found two of the long-sought-after ring arcs, or partial rings, thought to exist around Neptune. The arcs were found in photographs returned by Voyager 2 early in the morning on August 11.

The two ring arcs are apparently associated with two of

the Neptunian moons also found by Voyager 2 earlier this month. The arcs appear to wrap approximately 45 degrees and 10 degrees, respectively, in the planet's equatorial plane. One is about 50,000 kilometers (about 30,000 miles) in length; the second is about 10,000 km (about 6,000 mi) long.

The first arc, the longer of the two, was seen just outside the moon 1989 N4, which orbits about 62,000 km (38,500 mi)

from the planet's center, or about 37,000 km (23,300 mi) from the planet's cloud tops.

The second arc appears to trail the moon 1989 N3 by approximately 90 degrees, or by about 80,000 km (50,000 mi). That moon orbits Neptune at a distance of about 52,000 km (32,300 mi) from the center of the planet, or about 27,300 km

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Far-Encounter Phase

On August 6, Voyager 2 began its eighteen-day "far-encounter" phase, which ushers in a higher level of activity than the just-completed "observatory" phase. Neptune's disk now captures about one-quarter of the narrow-angle camera's field of view.

Higher activity also means more telemetry data, so NASA's Deep Space Network (DSN) has added daily tracking coverage by the Very Large Array (VLA) in New Mexico and the Parkes Radio Telescope in Australia, in addition to 24-hour coverage by the DSN complexes.

The far-encounter phase started with an intensive series of scans across the Neptunian system enabling the ultraviolet spectrometer to search for auroral emissions from the planet. These system scans occur four or more times per day. The imaging cameras are focusing on the large-scale features in Nep-

tune's atmosphere, the newly discovered ring arcs, searches for new satellites, and on the other known satellites, as well. Bursts of high-rate data from the planetary radio astronomy (PRA) instrument and the plasma wave subsystem (PWS) are being recorded twice per day for later playback to Earth.

Also on August 6, the last full-scale dress rehearsal for the encounter, the final radio science operational readiness test, was conducted. The ten-hour test involved Voyager 2 and the tracking stations of the world-wide DSN.

On August 11, the health of the infrared instrument (IRIS) was assessed in preparation for the high-value observations later in far encounter. Over the years, IRIS has experienced a degradation in its sensitivity due to misalignment of its mirrors. Periods of heating (using tiny heaters on board the spacecraft) reduce crystallization of mirror bond-

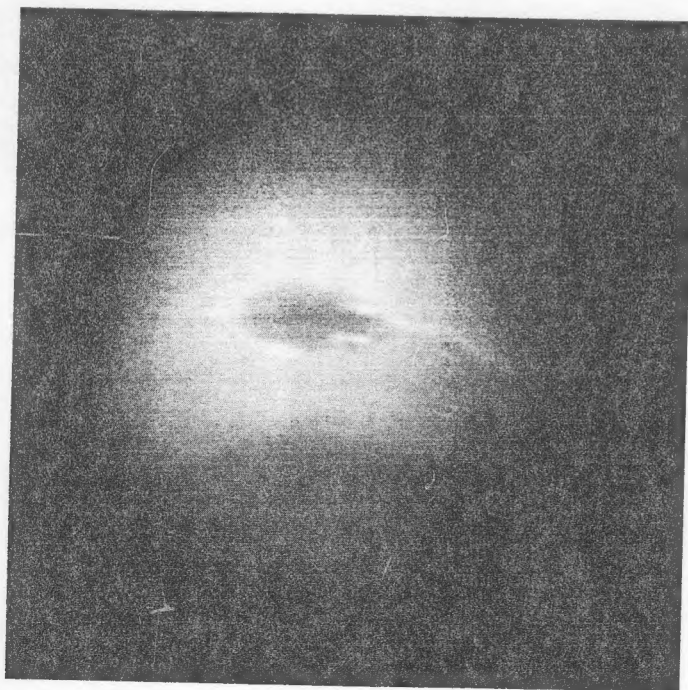
ing material and restore some of the original sensitivity, but stabilization of the instrument response requires several weeks of cooling prior to data-taking. A strategy to maintain careful balance between heating and cooling periods has been applied.

As Voyager 2 homes in on Neptune, activities on board the spacecraft require more of its computers' memory, so on August 13 the current backup mission load (BML) will be permanently removed from spacecraft to free up much-needed memory space. Removing the BML is a calculated risk, as the sequence is designed to autonomously operate the spacecraft through a minimum set of encounter observations should the spacecraft's only remaining radio receiver fail and prevent ground controllers from sending further commands to the spacecraft. Another BML will be loaded in the post-encounter phase to protect future long-term fields and particles observations in the outer solar system.

Neptune's position is now known about three times more accurately than just two weeks earlier; Triton three to six times better, depending on the component. Knowledge of the time of arrival is one-third better. Soon, the value of Triton's radius will no longer be a mystery. And by this time, the mass of Neptune is known three times better than at the start of the far-encounter phase, because the subtle tug of the planet's gravity can already be detected in Voyager's radio data.

On August 15, Voyager 2 will again fine-tune its flight path, following instructions arrived at after laborious computations by Voyager's Naviga-

Features at different latitudes move at different rates; their relative motions are a measure of atmospheric wind speeds. (P-34558)



tion and Spacecraft Teams. Immediately following this trajectory correction, Voyager 2 will turn about its roll axis to acquire a different lock star for its star tracker (the spacecraft uses the Sun, the Earth, and a star to maintain its orientation). This change from Achernar to Canopus will place the onboard fields and particles instruments in a better orientation for measuring magnetospheric properties during the days before Neptune closest approach.

The highest-value science observations in this phase will be the IRIS instrument's observations of the planet on August 16-18; the matching outbound observation in the post-encounter phase is equally important. These observations will tell us the planet's temperature, which may be combined with other Voyager data to provide the heat balance—the ratio of the amount of energy being given off by the planet to the amount of energy it receives from the Sun. This is a highly important measurement to make for planets (especially the gaseous ones) since it

allows scientists to deduce things about the body's interior, and unlock some of the secrets hidden by its clouds. The optimum times to make the heat balance measurements will be on August 18 (inbound) and September 1 (outbound) when Neptune's disk should just barely fill the IRIS instrument's field of view.

The week before the spacecraft's closest approach to the planet (on August 25) will be filled with specialized observations of Neptune and its atmospheric features, its ring-arc system, Triton, Nereid, and the recently discovered small satellites. All eleven of Voyager's science investigations will be actively taking data. Fields and particles instruments will continue their search for Neptune's magnetosphere. The unambiguous sign of Voyager's entry into this strange domain of "whistlers," "chirpers," and electromagnetic static and hissing will be the crossing of the "bowshock" and the magnetopause region, estimated to occur between about 27 and 9 hours before Voyager 2's closest approach to Neptune.

Most of the flight teams will be busy night and day, analyzing data and dealing with any unexpected problems. The Navigation Team will be working especially hard to calculate all of the values needed for the final course correction and the late updates to the pointing and timing of critical observations.

The final aiming point for the encounter will be fixed on August 20 with the final course correction of Voyager 2's 12-year odyssey to the outer planets. After this, no changes to the flight path are planned—ever—for Voyager 2. Its fate will thus be transferred to the final slingshot over Neptune's northern polar region and the meager forces it may encounter in interplanetary and interstellar space.

This final maneuver is designed to adjust Voyager 2's position to heighten the probability that Voyager 2 will pass through the narrow area of space where Triton casts its shadow from the Sun and the Earth. Critical observations of Triton's atmosphere depend on passing through this region.

Mission Summary

Planet	Average Distance from Sun	Spacecraft	Elapsed Travel Time	Encounter Date	One-way Communications Time**	Max. Data Rate (bits/s)	Closest Approach Dist. (km) (from center of planet)	Closest Approach Dist. (km) (from cloud tops)
Earth	1 AU*	Voyager 1 Voyager 2	Launched Sept 5, 1977 Launched Aug 20, 1977					
Jupiter	5.202561 AU	Voyager 1 Voyager 2	18 mos. 23 mos.	Mar 5, 1979 Jul 9, 1979	37 min 52 min	115,200 115,200	348,890 721,670	277,400 650,180
Saturn	9.554747 AU	Voyager 1 Voyager 2	3 yrs 2 mos 4 yrs	Nov 11, 1980 Aug 25, 1981	1 h 24 min 1 h 26 min	44,800 44,800	184,240 161,094	123,910 100,830
Uranus	19.21814 AU	Voyager 2	8 yrs 5 mos	Jan 24, 1986	2 h 45 min	21,600	107,000	81,440
Neptune	30.10957 AU	Voyager 2	12 yrs	Aug 25, 1989	4 h 6 min	21,600	29,183	4,850

* 1 astronomical unit (AU) equals 149,597,870 km (92,960,116 mi)

** Radio waves travel at the speed of light (299,792.458 km/s or 186,291.033 mi/s)

(about 17,000 mi) from the planet's cloud tops.

Astronomers have long suspected the existence of such an irregular ring system around Neptune. Data from repeated ground-based observations hinted at the existence of disorderly strands of partial rings orbiting Neptune. Voyager's photographs of the ring arcs are the first photographic evidence that such a ring system exists.

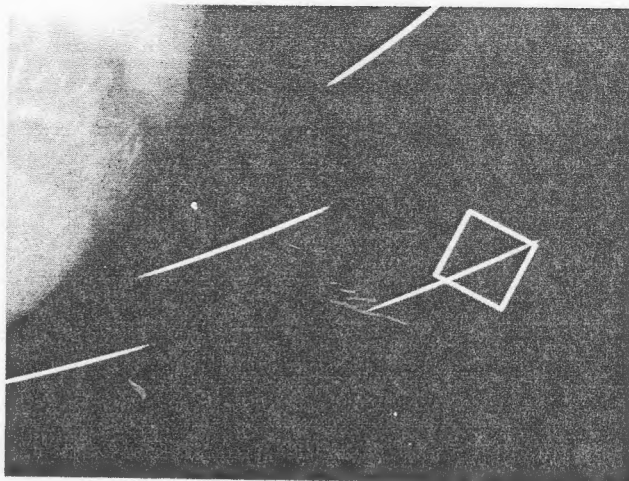
Voyager scientists said the ring arcs may be comprised of debris associated with the nearby moons, or may be the remnants of moons that have been torn apart or ground down through collisions. Close-up studies of the ring arcs by Voyager 2 in coming days should help determine their composition.

More ring arcs are expected to be found as the spacecraft nears the planet, Voyager scientists said.

Discovery of the two arcs when the spacecraft was still about 21 million km (13 million mi) from Neptune gives the Voyager team time to schedule detailed imaging of the ring arcs when the spacecraft comes within 4,850 km (3,000 mi) of the planet the night of August 24/25.

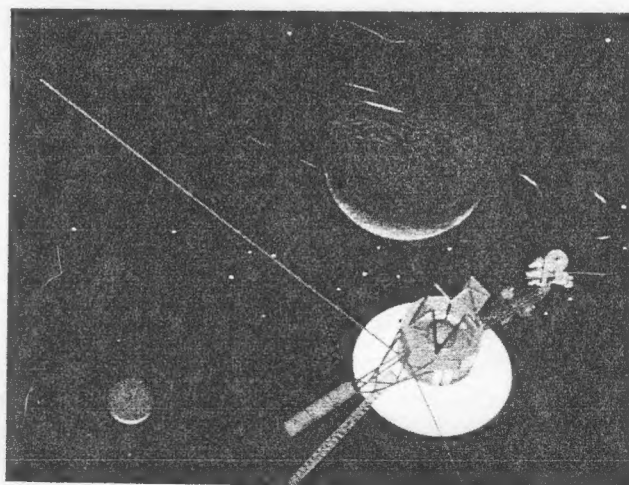
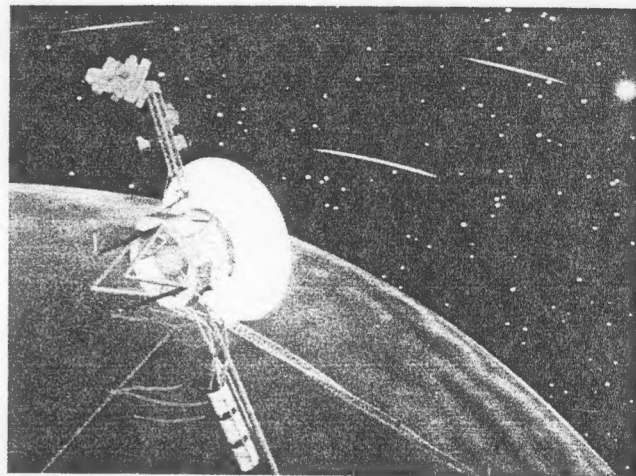
Recorded Status

Recorded mission status reports are now available by calling 818-354-0409.



Detailed observations of the newly-discovered ring arcs will include imaging, photopolarimetry, and radio experiments. (P-34513)

As Voyager 2 slips behind the planet, the radio science experiment will execute a precisely timed limb-tracking maneuver to study the planet's atmosphere. (P-34514BC)



Its last planetary mission fulfilled, Voyager 2 will catch a final glimpse of the crescents of Neptune and Triton. (P-34516BC)

Credits: Voyager Mission Planning Office and JPL Computer Graphics Lab

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